TECHNICAL EDUCATION AND SKILL FORMATION IN THE ORGANISED INDUSTRIES IN INDIA SINCE 1961

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A C K N O W L E D G E M E N T

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(**ZEBA SHEEREEN**)

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Chapter I

I N T R O D U C T I O N

Economic development is defined as growth accompained by change — change in the structure of the economy, Polity and Society. It is generally accompained by decline in agriculture's share of the gross national product and a corresponding increase in the share of such sectors as manufacturing, utilities, financial institutions, construction and government administration. There is also a shift in the occupational structure of labour force and increase in the degree of education and training.[1]

It has been observed in most of the developing nations that there is abundance of labour, but this surplus labour is not very beneficial to its economic development since it lacks skilled workers. This is one of the reasons for the disappointing results of their developmental efforts. It is now established that expenditure on education is primarily the investment of human capital which plays an important role in the economic upliftment of a country. The key to any development effort is the formation of a human capital. According to Schultz when human capabilities do

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1. Clarence Zuvekas, Economic Development, An Introduction. Macmillan Press Ltd., London 1979, p. 9

not keep ahead of Physical capital they become limiting factors in economic development. It is mainly because of this that most of the developing countries place emphasis on striking a balance between material investment and education and training of their labour force.

To equip its labour force with necessary technical skills especially in the area of engineering and technology the government put great emphasis on technical education.

The purpose of technical education is to produce trained manpower in adequate numbers for the economic development of the country.[2] It is one of the most significant components of human resource development spectrum with great potential for adding value to products and services, for contributing to the national economy and improving the quality of life of the people.[3]

Technical education is of paramount importance. This is education through which certain types of skills are

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2. Government of India, Ministry of Human Resource Development (Department of Education). Annual Report 1986-87 Part I, 1987.

3. Government of India, Ministry of Human Resource Development (Department of Education) Annual Report 1987-88 Part I, 1988

acquired that would help in increasing the efficiency and productivity of human beings. It can be economically justified if it concentrates on basic technical skills that do not quickly become obsolete as technology changes and can be easily transferred from one industry to another. This chapter consists of three sections. Section one deals with Growth of technical education in India, Section two, the objective and sources of data and section three the concluding remarks.

1. Growth of Technical Education in India

During the past four decades there has been a phenomenal expansion of technical education facilities in India.[4] Expansion and diversion of the facilities of Technical Education had been carried out steadily through the different five year plans.[5]

To accelerate the progress of the country it has been expanded to such an extent that India today has one of the largest pools of engineers and technicians at various levels anywhere in the world.

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4. Government of India, Ministry of Human Resource Development (Department of Education), Annual Report 1987-88 Part I, New Delhi 1988.

5. Government of India, Ministry of Education, Annual Report 1984-85, New Delhi 1985.

It was realized as early as 1945 that industrialization of our country depended to a large extent on adequate supply of engineering personnel. The creation of All India Council for Technical Education in 1945 as an apex body at the national level supported by its Regional Committees was entrusted with the responsibility of coordinated development of technical education. In addition to this the Report of the Scientific Manpower Committee in 1947 had far reaching influence on the development of skilled manpower. The development of technical education as it relates to industry was promoted through the Apprenticeship Act (1961), the Industrial Training Institute (ITI's) and Junior Technical Schools for the skilled workers and the spread of Polytechnics for the technicians.[6]

There is no doubt that India made good financial investment in creating a sound education infrastructure to stimulate the pace of development. This result has been most successful on quantititive front.

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6. Government of India, Report of the Education Commission 1964-66.

Table 1.1

Growth in Number and Outturn of the Degree and Diploma Level Institutions

Selected Years

Year	Degree Level		Diploma Level	
	No. of institution	Outturn	No. of institution	Outturn
1947-48	38	1270	53	1438
1960-61	102	5603	195	7969
1970-71	134	18469	301	15950
1980-81	166	19929	355	34977
1983-84	205	24699	526	40050

Source: Computed from table A.6 in the Appendix.

The above table reveals that there has been considerable expansion both in the number of institutions and the annual outturn of degree and diploma level engineers.

The average growth rate of technical education between 1947-48 and 1983-84 has been quite impressive. The number of institutions conducting degree level courses in engineering have increased by 12.2% over the entire period and outturn by 51.2%. Similarly for Polytechnics, the institutions have increased by 24.8% and outturn by 74.6% respectively during the same period.

Thus it is the middle level personnel or technicians who have increased more than the graduate engineers.

The phenomenal increase in the technical education was made possible by concerted effort of the government. Acute shortages of engineering skills during the First Plan made it clear that the success of plans depended on an adequate supply for engineering personnel. To make an overall assessment of the required engineering skills, the Planning Commission set up the Engineering Personnel Committee in 1955. The committee in its report in 1956 observed that while engineering education started more or less at the same time in India as in Western Countries, like U.K. and U.S. but progress in India was slow and restricted.[7]

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7. Government of India, Planning Commission, Report of the Engineering Personnel Committee 1956. New Delhi, 1957.

The productivity of labour or investment in India is much lower than in countries like U.K. or Japan. The growth rate of our economy does not indicate that we have the third largest population of qualified scientist and engineers next only to U.S.A. and U.S.S.R.

2. Objective, Data Sources, Limitations and Plan of Study.

(a) Objective of the Study :

The present study is an attempt to examine if the technical education in India has served its main purpose, that of supplying required technical manpower for the economic development of the country during the period 1961-84.

The outturn figures of graduate engineers and diploma holders have been taken to indicate the supply position and the growth rate of industrial production to indicate the demand for those personnel.

The technical training for industry is concerned with the following levels of skills:

(i) Semi-skilled and skilled workers (including Ist line Supervisors)

(ii) Technicians (diploma holders) — both Supervisory and higher technicians or technologist.

(iii) Engineers (graduates).

(iv) Research and Design Engineers (Post-graduates).[8]

We have taken here for our study the Technicians (diploma holders) and Engineers (graduates) only. The diploma courses are conducted at institutions called Polytechnics. The duration of the course is mostly three years after high school. The diploma courses are designed to train technicians who will eventually occupy supervisory positions like foreman-overseer etc. in industry and other technical organisation. For the Engineering courses the duration is generally four years with intermediate in Science or five years with the higher secondary/pre-university as minimum qualifications for admission. Skilled workers are trained at the industrial Training Institute.

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8. Government of India, Report of the Education Commission 1964-66.

(b) Nature and Source of data :

The data used here was obtained largely from the Institute of Applied Manpower Research (IAMR).[9] Other sources of data include some Government of India Publications. The following is list of reports and other publications used in the study.

Government of India Publications

(i) Survey Reports of Facilities of Technical Education, Northern, Eastern, Western and Southern region.

(ii) Consolidated report entitled 'Survey of Technical Education Facilities in India 1970-75. Ministry of Education, New Delhi.

(iii) Division for Technical Education, Ministry of Education and Culture.

(iv) Technical Education in India Today, Ministry of Scientific Research and Cultural Affairs.

(v) Engineers in India, Number and Distribution 1955. Planning Commission, 1957.

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9. I owe a large part of the data from IAMR to Dr. R.G. Varshney's help and cooperation.

(vi) Technical and Vocational Education in India 1979 and 1983. Ministry of Education and Culture.

(vii) Economic Surveys, Ministry of Finance.

Reports :

(i) Report of the Engineering Personnel Committee 1956.

(ii) Report of the Working Group on Technical Education.

(iii) Report on the Employment Pattern of Engineering Graduates and Diploma holder, DGET, Ministry of Labour Employment and Rehabiliation.

IAMR Publications :

(i) Stock of High Level Manpower, Engineering Graduates and Diploma holders, New Delhi 1979.

(ii) Stock taking of Engineering Personnel 1963.

(iii) Fact Book on Manpower.

The data is completely of secondary nature. The outturn figures of degree holder engineers provided by the Ministry of Education in consolidated survey Report of Facilities of Technical Education has been used after excluding the outturn of non-engineering degree courses such as Pharmacy. They have also been adjusted for comparability and completeness. The outturn figures of the diploma holder engineers provided by Survey Reports of facilities of Technical education, Ministry of Education have been used after excluding outturn of non-technical diploma courses such as Pharmacy, Secretarial Practice. They have also been adjusted for making them complete and comparable.

(c) Limitations of Study :

Since data used here has been obtained from secondary sources, it should be taken with all its shortcomings. Besides this in the study we assume that total annual outturn reflects the supply position of degree and diploma engineers in any given year, though supply strictly speaking should also include engineering personnel who passed in previous years. In other words we take the supply of engineering personnel as a flow variable and not as a stock one.

(d) Plan of Study :

Our study begins (Chapter II) with survey of relevant literature. It deals mainly with the available literature on human capital. Most of the studies have been done for the U.S. economy and similar studies do not seem to have been conducted for the Indian economy.

In chapter III we present analysis of the supply and demand sides of the problem with a view to examine if the engineering institutions have succeeded in providing the necessary technical personnel for the development of the country. Chapter IV consists of summary and conclusion of our study.

3. Concluding Observations

The key to any development effort is the formation of human capital. This human capital consist amongst other things, of investment in education. The investment in technical knowledge of labour force is essential for economic growth of the country. Soon after independence India realized that for rapid economic development we would require a pool of scientists and technical personnel

especially engineers. Thus there was rapid expansion in technical education facilities in the country with the result that today we are in a position to undertake advanced and sophisticated jobs in engineering design, fabrication etc. including that of the satellites.

Chapter II

Human Capital and Economic Development

This chapter concerns itself mainly with a survey of available literature on education and its importance in economic development. The role of human capital in economic development of the countries can hardly be emphasized. Human capital formation consists of investment made in man either through education, health and nutrition or through on-the-job training. Attempt has been made in section one to deal with theoretical as well as empirical studies on education and economic development. Section two offers some concluding remarks.

Gary Becker, T.W. Schultz and Jacob Mincer have done significant research on the importance of education as a source and measure of human capital.[1]

1. Human Capital and Development

(a) Some Theoretical Issues :

Economic development is taken mainly as the

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1. Bevars D. Mabry; "Introduction to the Quality of Labour and Human Capital", in Economics of Manpower and the Labour Market. Intext Educational, New York 1973, p. 168.

investment of present resources for increased future production or it is the investment of savings for growth. A country's development effort is usually measured by the volume of its investment. It is considered that more investment would eventually lead to rapid economic development. But it is very important to determine the areas where investment has been made.

Recent researches have revealed that increases in output over long periods are more due to non-physical factors described as increases in productivity of the physical factors than to increases in physical inputs such as labour, capital and natural resources.[2] In the underdeveloped countries the capital coming from outside in mainly utilised for formation of physical capital — structures, equipment and inventories. It is generally not available for investment in man. Hence human capabilities in general tend not to keep ahead of physical capital and they become limiting factors in economic growth.[3]

The rate of modernisation of a country is associated

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2. H.W. Singer; "Education and Economic Development", in International Development, Growth and Change. McGraw Hill Book Company, New York, Toranto London, 1964, p.68.

3. T.W. Schultz; Investment in Human Capital". American Economic Review March 1961.

with its stock and rate of accumulation of human capital. Human capital defines people as a capital asset which yields a stream of economic benefits over their working life. Expenditure on education and health can therefore be regarded as investment because this improves the quality of human beings, increases their adaptability to the changing requirements of the economy, and in many cases lengthens their working lives. All these result in greater productivity and lead to greater production. As such human capital is like material capital.[4]

Human Capital Formation is the process of acquiring and increasing the number of persons who have skills, education and experience critical for economic and political development.[5]

Investment in human capital may be of various forms. As Professor Schultz suggests a typical list would be [6] —

(i) Health facilities and services, broadly conceived to

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4. A.N. Agarwal, "Capital Formation and Savings", in Indian Economy Problems of Development and Plannings. Wiley Eastern Ltd., New Delhi, 1987, p.231.

5. Frederick Harbison, "The Need for Developing Human Resources", in Economic Development: Challenge and Promise. edited by Stephen Spiegelglas and Charles J. Welsh. Printice Hall INC. U.S. 1970, p.116

6. Gerald Meir; Investment in Human Capital — Note" in Leading Issues in Economic Development. Third edition, New York, Oxford University Press, 1976, p.520.

include all expenditures that affect the life expectancy, strength and stamina and the vigour and vitality of people.

(ii) On the jon training including old style apprenticeship organized by firms.

(iii) Formally organized education at the elementary, secondary and higher levels.

(iv) Study programmes for adults that are not organized by firms, including extension programs notably in agriculture.

(v) Migration of individuals and families to adjust to changing job.

We are concerned here with only two types of investment in human capital. Firstly through education, that includes general and technical education and secondly health which includes health care services, medical education, family welfare, nutrition. These two improve the quality of human capital.

Education improves the level of understanding, it also adds to the capacity of human stock to produce more. Expenditure on items of health care, increases the physical

and mental efficiency of the people.[7]

Expenditure on health and nutrition conventionally has been classified as consumption and thus failed to show up as factors affecting national growth. But studies show that increases in national output have been large compared with increases of land, man hours, and physical reproducible capital and that investment in human capital is probably the major explanation for this difference.[8]

The large nutrition benefit for developing countries is the reduction in productivity losses caused by the debility of a substantial portion of the labour force. Due to better nutrition, the working life lengthens and this reduces the countries' dependency ratio — the proportion of those in the population who produce no income to those who work. In 1960 for every 100 persons of working age in a typical developing country, there were an estimated 76 dependents compared to only 59 in a typical industrialized country. Lower dependency ratio means increase in per capita income and potentially per capita savings.[9]

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7. A.N. Agarwal, op. cit. p.233.

8. Allan Berg, "Nutrition Factor", Brooking Institutions in Leading Issues in Economic Development edited by Gerald Meir. Third edition, Oxford University Press, New York, 1976, p.503.

9. Allen Berg, ibid. p.504.

The less developed countries believe that their development depends on amount of physical capital. But ability to use capital effectively depends on natural and human resources. Harbison has aptly pointed out that the quality of human resources is very important because it affects the capital absorptive capacity of the country and education is mainly that important factor that determines the quality of human resources.[10] In his view the developing countries suffer from two basic problems — shortage of persons with critical skills in the modern sectors and surplus labour in both modern and traditional sectors. The shortages faced are mainly of highly educated professionals like scientists, agronomists, engineers and doctors. Then there is also shortage of technicians, nurses and technical supervisors.[11]

According to Johnson the experience of past years shows that emphasis on investment in material capital in the methodology of economic planning was a mistake and that economic development depends vitally and largely on creation of labour force both equipped with necessary skills for modern industrial production and ready to accept and promote

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10. Frederick Harbison, op. cit. p. 126

11. Frederick Harbison, op. cit. p. 115

economic and technical change.[12]

Education is treated both as an investment activity and as a consumption activity. In Professor Schultz's view education is consumption activity giving satisfaction to person at time he obtains it. But it is also investment activity undertaken for the purpose of acquiring capabilities that render future satisfactions or that enhance future earnings of the person as a productive agent. It is treated as investment and its consequences as form of capital. Education becomes part of person so it is called human capital. Education treated as investment on the hypothesis that important increases in national income are a consequence of additions to the stock of this form of capital.[13]

Schultz firmly believed that inclusion of human capital formation in the resource base explains why national income has had a tendency to increase more rapidly than the recorded base, and why the ratio of capital to income has had a tendency to decline. To indicate the significance of labour

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12. H.W. Johnson; "Towards a Generalized Capital Accumulation Approach to Economic Development". in Economics of Education vol.I, Selected Readings, edited by M. Blaugh. Penguin Bokks, 1968, p. 34.

13. T.W. Schultz; "Cost of Capital Formation by Education", in Investment in Human Capital: The Role of Education and Research. Free Press, New York 1971, p. 78.

force embodied with substantial amounts of human capital Schultz poses the question: how productive a country like India would be if it is endowed with physical stock of U.S. while no change occurs in its supply of skills and educated labour force.[14]

(b) Some Empirical Facts :

Schultz advocates that it is the growth in human capital which explains the discrepancy in the U.S. growth rates between national output and tangible capital. The rates between year 1919 and 1957 were 3.1% and 1.8%. Also the discrepancy between growth rates of output and tangible capital input is widening and this widening is not due to increasing growth rates of other physical inputs. Rather the latter have declined from 2.2% to 0.8%.[15]

According to Schultz investment in human capital accounts for most of the impressive rise in the real earnings per worker. He and others have argued that increases in the quantity of material capital and in the numbers of the working population do not account for the whole of the economic growth in the U.S. in recent decades as measured by

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14. Bevars D. Marby, op. cit. p. 166

15. Ibid pp. 186-87

real income. From studies of the national Bureau of Economic Research for the same period, Schultz has shown that between 1919 and 1957 in the U.S. with addition of only 1% in the total inputs of tangible capital and in man hours per annum, real income increased at the rate of about 3% per year. He found the difference between measured inputs and measured output in Latin America to be substantial, though less than in the U.S. Working on research conducted by Personnel of the Economic Commission for Latin America, Schultz found for 1945 to 1955 an increase in economic growth of 4.88% per year as compared with an increase in inputs, including land of 3.12% per year. Presumably this difference between U.S. and Latin America is accounted for in part by substantial differences in the stock of human capital in the two regions.[16]

The importance of a background of literacy and know-how in economic development is well illustrated by the speed with which Western Europe recovered with Marshall Plan aid. Japan's rapid post war recovery and present strength must be due in large measure to making effective

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16. W.J. Waines, "The Role of Education in Economic Development", in Economic Development, Challenge and Promise. edited by Stephen Spiegelglas and Charles J. Welsh. Printice Hall INC, New Jersey, 1970, p. 125

use of capital with human resources of great strength, because it had limited natural resources. Israel, too, is a striking modern example of rapid development. In the 8 year period between 1950 to 1958 aggregate gross national product increased at an annual rate of 10% and gross national product per capita grew at an average rate of 5% per year. Even a superficial comparison of the rate of growth in Israel and other Middle East countries which have similar financial resources and are similarly or better endowed with natural resources suggests that it was the quality of Israel's human resources that made rapid growth possible. It was receptive to education and to new techniques and skills and highly adaptable to new situations .[17]

Researches indicate that the increase in the education and training of workers and the advance of knowledge generally together with economies of scale account for a large part of the growth otherwise unexplained. In one of his other estimates Schultz has revealed that in the U.S. between 1929 and 1957, at least 21% of the increase in national income was the contribution of education of the labour force. The real income of the U.S. rose by $ 152 billion, of which additional education of the labour force

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17. W.J. Waines, op. cit. p. 127

contributed about $ 32 billion.[18]

Denison has used a different approach to find the contribution of education to growth for the same period, 1929-1957. During this period the amount of education the average worker had received was increasing almost 2% a year and this was raising quality of labour by 0.97% a year and contributing 0.67% to the growth rate of national income. It was source of 23% of the growth of total real national income and 42% of the growth of real national income per person employed.[19]

In India human capital has been accorded unimportant status. This is brought out vividly when comparison is made with the advanced countries. While India devoted generally five to six percent of its national income to education the U.S.A. earnmarked about 13% of its GNP (1958). During the initial stage of development in U.S. the investment in education increased much more rapidly than in the formation of physical capital, but in India the opposite has been the case, with the rate of growth of

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18. W.J. Waines, op. cit. p. 126

19. Edward F. Denison; "Education: Economic Growth and Gaps in Information", Committee for Economic Development. Journal of Political Economy. Vol. L XX, Supplement, October 1962 No. 5 Part 2 pp. 124-128

physical capital being consistently much higher than that of human capital.[20]

2. Concluding Observations

Although the objective of adding to the stock of physical capital has dominated investment discussions, it has now become evident that a high priority must also be assigned to investment in human capital. Many studies of economic growth in advanced countries confirm the importance of non-material investments. These statistical investigations indicate that output has increased at a higher rate than can be explained by an increase in only the inputs of labour and physical capital. The "residual" difference between the rate of increase in output and the rate of increase in physical capital and labour encompasses many "unidentified" factors, but a prominent element is the improvement in the quality of inputs. Although some of this progress may be incorporated in physical capital, the improvements in intangible human qualities are more significant.[21]

In the advanced countries like U.S. and Japan, high

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20. A.N. Agarwal, op. cit. p. 233
21. Meir, op. cit. p. 519

priority was given to investment in human beings and they have been a major source of their development, but it is sad to note that in less developed countries no such thought was given and they made negligible investment in human factor. As a result we find that in these countries there is low labour efficiency and limited specializations. In the past decade India made efforts to improve the quality of its human capital and now we observe that it has made considerable progress. Assimilation and diffusion of new ideas are essential to remove economic backwardness and pave the way for economic development.

Chapter III

Supply and Demand of Technical Manpower

Economic development is often taken as synonymous with the development of the industrial sectors. Other sectors are taken to lend a supporting hand to it. The growth of industrial sectors requires trained technical personnel and these are provided by various technical institutions. Engineers are one such category of technical personnel that are so essential for the industiral development. In this chapter we have tried to analyse their position with respect to industrial growth rate in a bid to assess the adequacy of the source of their supply. Section one here concerns with the supply of technical manpower, section two with the demand for technical manpower and section three consists of the concluding remarks.

The constraints of physical resources is not the only limiting factor for economic growth. Science and technology could be usefully exploited to make up for their insufficienly technological innovation or by introduction of new inputs. The responsibility for using science and technology for economic growth lies with the scientific and technical manpower. A number of studies in the U.S.A. and West European countries have shown that the total output index

of an economy is directly related to the number of qualified scientists and engineers in the labour force, and that the growth rate depends on the quality and competence of technical manpower.[1]

In India the number of qualified scientists and engineers has increased by an average rate of more than 20% per year for the past twenty years, but the growth rate of the economy has been much below this rate. India today has third largest population of qualified scientists and engineers next only to the U.S.A. and the U.S.S.R. For every 1,000 persons there was one graduate scientist or engineer in India in 1971. This compares well with the numbers in the U.K., Japan or in West European countries. But the product or per unit of investment in India is much lower than in these countries.[2]

Here we have concerned ourselves only with the engineering personnel, both at degree and diploma level in the formal system of education.

As we have mentioned in the introduction, India made

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1. P.R. Sengupta, "Utilisation of Scientific and Technical Manpower for Economic Growth", in Manpower Journal vol. XIII No.1, April-June 1977, IAMR, New Delhi pp. 41-42.
2. P.R. Sengupta op. cit. p. 42

good financial investment for the increase in technical education facilities. As a result there was considerable expansion both in the number of institution imparting degrees and diploma in engineering and in the annual outturn of degree and diploma level engineers. In 1947-48, the number of institutions for degree level education was only 38. This increased to 102 in 1960-61 and to 205 in 1983-84. Similarly the Polytechnic in the country increased from 53 in 1947-48 to 195 in 1960-61 and 526 in 1983-84. The annual outturn has also registered a phenomenal increase (see table 1.1 in introduction).

1. SUPPLY OF TECHNICAL MANPOWER

We shall discuss the supply position of degree holder and diploma holder engineers separately.

(a) Supply of Degree holder Engineers :

The figure of the outturn of graduate engineers in the formal system of technical education in India provide us with their supply position. The following table gives a branch wise break up of the outturn of engineers from 1961-62 to 1983-84.

Table 3.1

Degree holder Engineers of Formal System of Education in India: Selected Years

S. No.	Speciality	YEARS					
		1961-62	1966-67	1971-72	1976-77	1981-82	1983-84
1.	Civil	2232	2957	3141	4405	5352	6297
2.	Mechanical	1829	4047	5864	4660	5639	6117
3.	Electrical	1301	3033	4436	2912	4029	4305
4.	Chemical	300	742	1388	1177	1322	1312
5.	Mettalurgical	311	407	756	446	486	560
6.	Textile	185	167	310	349	384	381
7.	Architecture	150	345	403	502	453	608
8.	Mining	63	247	137	88	154	208
9.	Electronics & Telecomm.	179	352	878	1165	1579	1775
10.	Others	343	581	885	850	1148	1503
	TOTAL	6893	12878	18198	16554	20546	23066

Source : Computed from table A.I in the Appendix.

The foregoing table shows some interesting features. If we consider the supply of graduate engineers in absolute terms, then we find that the maximum increase in outturn has been during the period 1961-62 to 1966-67. The total outturn was 6893 in 1961-62 and 12878 in 1966-67. There has thus been an increase of 87 percent during this period. This was a significant increase. .Another notable feature was that the annual outturn fell to 16554 in 1976-77, from 18198 in 1971-72, a decline of 9 percent for the period. Thereafter there was a modest rise over the rest of the period.

When we take the breakup of graduate engineers by speciality then we note that in India civil and mechanical engineers constitute the bulk of the total number of engineering graduate for the period under review. Their outturn has continuously increased through the years. This could be one possible reason why we have been able to construct various multipurpose projects for power generation, irrigation and flood control and industrial complexes like Steel Plants. The other three branches where outturn was low were Textile, Architecture, Mining and Electronics and Telecommunication.

The increase in outturn of Chemical engineers was perhaps

most impressive. There was more than 100 percent increase between 1961-62 and 1966-67. The annual outturn rose from 300 in 1961-62 to 742 in 1966-67. The increase in Textile engineering was modest. The annual outturn in Mining Engineering was very fluctuating. From an annual outturn of 63 in 1961-62 it rose to 247 in 1966-67, but thereafter fell to 137 in 1971-72 and further slumped to 88 in 1976-77.

The following table shows the rates of growth of the outturn of the degree holder engineers for selected years.

Table 3.2

Growth in Degree holder Engineers of Formal System of Technical Education in India: Selected Years

YEAR	Degree Level	
	Outturn	
	No	Average Annual Growth rate
1961-62	6893	-
1966-67	12878	17.36
1971-72	18198	8.26
1976-77	16554	- 1.80
1981-82	20546	4.82
1983-84	23066	6.13
Average growth rate between 1961-62 and 1983-84		10.66

Source : Computed from table 3.1

The annual growth rate of the outturn of degree holder engineers has been very fluctuating. During the early seventies there was considerable decline in the growth rate as compared to earlier period; after 1975-76 it again rose but never reached the previous high rates. (See Table A.3 in the Statistical Appendix for details).

As the foregoing table reveals the average growth rate between 1961-62 and 1966-67 was as high as 17.36%, thereafter it fell and during the period 1971-72 to 1976-77 it actually declined by 1.8%. It then slowly pickedup for the rest of the period. The overall average growth rate between 1961-62 and 1983-84 has been 10.66% which is quite significant.

(b) Supply of Diploma holder Engineers :

Again the branch-wise break up of diploma holders given the following table provide us with some interesting features.

Table 3.3

Diploma holder Engineers of Formal System of Education in India: Selected Years

S. No.	Speciality	YEARS					
		1961-62	1966-67	1971-72	1976-77	1981-82	1983-84
1.	Civil	4857	6352	3163	8582	12828	14111
2.	Mechanical	2375	8611	5827	7625	10273	11137
3.	Electrical	2091	5682	4277	5700	8112	8107
4.	Chemical	-	56	147	171	273	337
5.	Mettalurgical	10	22	98	157	158	190
6.	Textile	296	289	359	536	748	1035
7.	Architecture	6	11	46	125	224	317
8.	Mining	204	210	74	196	430	458
9.	Electronics & Telecomm.	93	113	411	929	1469	1850
10.	Others	417	835	761	1320	1821	2508
	TOTAL	10349	22181	15163	25341	36336	40050

Source : Computed from Table A.2 in the Appendix.

The annual outturn of Diploma holder engineers also show more or less the same features, as that of graduate engineers. The annual outturn increased from 10349 in 1961-62 to 22181 in 1966-67 — an increase of about 114% over the five year period. But then it declined to 15163 in 1971-72 a fall of 31.6%. Thereafter it increased continuously though not at decreasing rate.

Compared to other branches the outturn of diploma holder engineers in Mettalurgical engineering has been rather slow. Their annual outturn was only 10 in 1961-62, which increased to 22 in 1966-67 and further to 98 in 1971-72. Another branch that had a low outturn was Architecture. The outturn of diploma holders in mining engineering was far more than those of graduate engineers and except for 1971-72 when it fell to 74, there has been a continuous increase and the figure stood at 458 in 1983-84, as compared to 204 in 1961-62.

The following table shows the rate of growth of the outturn of the diploma holder engineers for selected years.

Table 3.4

Growth in Diploma holder Engineers of Formal System of Technical Education in India: Selected Years

YEAR	Diploma Level	
	Outturn	
	No	Average aanual growth rate
1961-62	10349	-
1966-67	22181	22.86
1971-72	15163	- 6.32
1976-77	25341	13.42
1981-82	36336	8.67
1983-84	40050	2.04
Average growth rate between 1961-62 and 1983-84		13.04

Source : Computed from Table 3.3.

The annual growth rate of diploma holder engineers has also shown fluctuating trend. Between 1960-61 and 1961-62, the growth rate was as high as 29.86%, but between 1966-67 and 1967-68 it fell to 0.37% (see Table A.3 in the statistical Appendix for details).

As shown by the above table 3.4, the average annual growth rate of diploma holder engineers during the 1961-62 to 1966-67 was 22.86% but declined by 6.32% between 1966-67 and 1971-72. The overall average growth rate of 13.04% for the past twenty-two years, ie. 1961-62 to 1983-84 has been more than that of the graduate engineers.

2. DEMAND OF TECHNICAL MANPOWER

The statistics of demand for technical manpower can be obtained among others by the following two methods :

(a) The actual amount of recruitment of engineers at various levels by both the private and public sector concerns.

(b) The number of vacancies advertised by different concerns.

In all likelihood the two, although not identical, move in the same direction. Unfortunately figures are not available on a comprehensive basis in either of the two categories. We have therefore done the next best thing by taking the rate of growth of industrial production as representing the demand for those personnel.

The industrial programme was expected to strengthen the industrial base and make a significant advance towards the creation of a modern self-reliant industrial structure. The decline in grwoth rates of industrial production even when investments increased was attributed to shortage of raw materials and poor agricultural base. But even now when our agricultural production has picked up considerably and industrial sector has been given more impetus, the growth rate falls short of the target that it should have achieved. The average growth rate of 5% is well below the required rate of 8% - 10% per annum.

Table 3.5

Rates of Growth in the Demand for and Supply of Graduate and Diploma holder Engineers: Selected Years

YEAR	DEMAND	SUPPLY	
	Ind. Prod.	Degree holders	Diploma holders
1960-61	-	-	-
1961-62	6.6	23.02	29.86
1963-64	9	8.27	7.40
1966-67	0.3	27.39	25.88
1971-72	3.3	- 1.46	- 4.93
1973-74	- 0.2	- 6.85	5.99
1976-77	9.6	8.14	13.90
1979-80	- 1.7	- 0.10	4.75
1981-82	9.3	3.09	3.88
1983-84	6.7	5.53	- 0.17

Source : Computed from Table A.5 in the Appendix.

The above table reveals that the growth rate of industrial production has varied from a high of 9% in 1963-64 over 1962-63 to a low of 0.2% in 1973-74 over the previous year. For the past twenty-two years, the growth rate of industrial production has always been fluctuating.

The percentage increase or decrease in any given year has been computed over the previous year and we have taken 1960-61 as our base and assume that in this year the demand for and supply of graduate and diploma holder engineers are in equilibrium.

Matching the demand with supply, we find that the supply for graduate engineers and diploma holder engineers from our institutions had exceeded the demand for these personnel in the two years 1961-62 and 1966-67. In other words there was over-production of graduate and diploma level engineers in our economy,

With 1960-61 as base year we observe that in 1961-62 the supply of graduate engineers increased by 23.02% and that of diploma level engineers by 29.86%, although the demand had increased by only 6.6% during the same period. This was the period when emphasis was placed on increasing

the outturn of these personnel and the pace of economic development has not sufficiently picked up. The three branches of engineering that had maximum outturn were Civil, Mechanical and Electrical. The other branches that had low outturn were Electronics, Textile, Architecture etc.

In 1966-67, the economy went through a period of recession so that the annual growth rate of industrial production increased by only 0.3% over the previous year, reflecting a low demand for engineering personnel.

However there was phenomenal rise in supply of diploma and degree level engineers, that increased by 25.88% and 27.39% in 1966-67 over the year 1965-66 respectively.

After 1966-67, the supply of graduate engineers was never steady. It had declined by 1.46% in 1971-72 and again by 0.1% in 1979-80. In case of diploma level engineers their growth rate also declined by 4.93% but it had increased by 4.75% in 1979-80. However in 1971-72 the industrial production increased by a modest rate of 3.3% over previous year, but declined by - 1.7% in 1979-80 over the year 1978-79. Thus in 1971-72, the supply of both level engineers had fallen short of demand.

The supply of graduate engineers has in most period fallen short of their demand. The growth rate figure for the years 1963-64, 1971-72, 1976-77, 1979-80, 1981-82 and 1983-84 indicate that the supply was less than the demand for degree holder engineers. But this was not the case with diploma level engineers. Their supply was less only in the years 1963-64, 1971-72, 1981-82 and 1983-84.

Between 1975-76 and 1976-77 the demand for graduate engineers increased at the rate of 9.6%, but the supply increased by 8.14% for this same period, not very much below the target. It is very interesting to note that in the year 1981-82, the demand increased at a high rate of 9.3% but for this same period the supply increased at a very slow rate of 3.09% over the year 1980-81.

The supply of diploma level engineers has generally been more than their demand. The increase in demand for the diploma level engineers was 9.6% in 1976-77, over the previous year, but the supply had increased by 13.90% for the same period. However in 1981-82, the growth rate of industrial production had increased by 9.3% over the year 1980-81, but the growth rate of diploma holder engineers increased by only 3.88% over the previous year 1980-81.

Another interesting feature was that in 1983-84 the growth rate of industrial production increased by 6.7% but the growth rate of diploma level engineers declined by 0.17%.

The growth rate of engineering personnel as well as that of industrial production has shown fluctuating trends. In case of degree holder engineers the supply has been less than their demand, but in case of diploma level engineers the supply has been more than the demand. Therefore the middle level personnel have increased more rapidly.

3. CONCLUDING REMARKS

The development of the country in a planned manner made it imperative that there should be rapid industrialization. Depending on agriculture alone, would not have increased the pace of economic development, for that we required scientific and technical personnel. Amongst them degree and diploma level engineers form an important category. Their growth rate is clearly linked with the growth rate of industrial production because they form the back bone of industries. Hence it was essential to study the trend in their growth rate and compare it with that of the industrial production.

From the study in this chapter we find that the annual outturn of both the degree level and diploma level engineers have shown a fluctuating trend. However the annual outturn in Civil, Mechanical and Electrical engineering have increased more rapidly than the other branches. The branch of Mining engineering has shown a very inconsistent annual outturn. It is much less than what is required by India. Electronics and Telecoomunication is one branch where annual outturn has increased very rapidly and may be one reason for indigenous production of our defence and industrial equipment besides using science and technology for peaceful purpose.

The growth rate of degree, diploma as well as industrial production has shown fluctuating trend. In 1971-72 the growth rate of degree level engineers increased by 8.26% over the previous year 1970-71, but the growth rate of diploma level engineers had declined by 6.32% for the corresponding period. Again in 1976-77 the growth rate of degree level engineers declined by 1.80% but there was an increase of 13.42% in case of diploma level engineers. For the twenty two year period between 1961-62 and 1983-84 the growth rate of outturn for the degree level engineers increased by 10.66% and that of diploma level engineers by 13.04%.

The growth rate of industrial production has also varied between the years. Except for the years 1963-64, 1976-77 and 1981-82 when industrial production increased by 9%, the growth rate has been very low.

By matching the demand for and supply of these personnel we find that in the case of degree holder engineers the supply has fallen short of the demand but for the diploma holder the supply has been more than their demand between the period 1961-62 and 1983-84.

Chapter IV

Summary and Conclusion

The economic development of developed nation onfirms the importance of non-material investment and lso establishes that economic development depends vitally creation of labour force which is equipped with neces- sary technical skills for modern industrial production nd ready to accept and promote economic development and echnical change.

We have examined in the foregoing pages if technical ducation in India has served its main purpose, that of upplying required technical manpower for the economic evelopment of the country during the period 1961-84. The ain limitation of the study is that the data used here are f secondary nature. We have also made two important ssumptions :

1. That the total annual outturn reflect the supply position of degree and diploma engineers in any given year, though supply should also include engineering personnel who passed in previous years. Therefore we have taken the supply of engineering personnel as a flow variable and not as a stock one.

2. The other assumption was that the rate of growth of industrial production indicates the demand of industries for degree and diploma holder engineers.

For the economic development of the country material capital as well as human capital are required. Human capital is a concept that includes investment made in man through various means such as education and health.

Health is an essential and important form of investment in human capital because it enhances the productivity and efficiency of the worker. It was formerly treated as consumption expenditure and thus failed to show as factor affecting national growth. Expenditure on health and nutrition lengthens the working life and also reduces the dependency ratio, so important for a developing nation.

The other major component of human capital is education. Harbison has pointed out that the quality of human resource affects the capital absorptive capacity of the country and it is education that determines and enhances this quality. Similarly Johnson has emphasized that economic development depends largely on labour force that is equipped with necessary skills and is ready to accept

and promote economic and technical change.

Many of the empirical researches were conducted by T.W. Schultz, Denison and Gary Becker. The statistical investigations indicate that output has increased at a higher rate than can be explained by an increase in only the inputs of labour and physical capital. Schultz argued that increases in the quality of material capital and in the numbers of working population do not account for whole of the economic growth in the U.S.

Education helps people imbibe more knowledge and also make the economy self-reliant and indigenous in character. Economic development is often taken to mean the industrial development of the country with agriculture and tertiary sectors, playing a supporting role to it. For industrialization of the economy a pool of scientific and technical manpower is required. Amongst the technical personnel it is the degree and diploma holder engineers that provide the backbone of the industries.

The history of the leading industrial nations shows an invariable connection betveen economic development and technical education. In Germany the study of applied chemistry was mainly responsible for development of its

chemical industry. In Belgium the promotion of industries was preceeded by important experiments in technical education. Japan began its modern development after the Second World War and has become the most important industrial country in the East by reason of her systematic efforts to extend facilities of technical education. All this indicates that provision of technical education an important condition for economic progress.

1. Technical Education in India :

For its economic development India required the technical personnel in large numbers and so it was deemed necessary that it should be trained inside the country rather than import them from foreign countries. As such the government set up the All India Council for Technical Education (AICTE) in 1945 as an apex body to coordinate the growth of technical education in the country. Besides this various committees were set up to evaluate the extent of our requirements of technical personnel and suggest ways and means to do so. The Report of the Scientific Manpower Committee in 1947 had far reaching effect on the development of skilled manpower. The Report of the engineering personnel Committee 1956 stated that though engineering education started more or less at the same time in India

as U.S. and U.K. but progress in India was slow. The Report of Working Group on Technical Education 1977 was also set up to review the present status of nations needs for these personnel during the coming decade ie. 1977-87.

All these steps led to phenomenal expansion of technical education and also on the annual outturn of graduate and diploma level engineers.

In 1947-48 there were 38 degree level institutions and 53 Polytechnics, to train the technicians. In 1960-61, the number had increased to 102 and 195 respectively, thereby showing an increase of 13% in case of degree level institutions and 21% in case diploma level institutions, between 1947-48 and 1960-61. The increase in number of institutions during the next twenty years was rather slow. In terms of absolute numbers, the institutions imparting degree level courses and diploma level courses increased to 166 and 355 respectively in the year 1980-81. Therefore between 1960-61 and 1980-81, the increase was of the order of 3.1% and 4% for degree level and diploma lvel institutions.

Similarly there was quite an impressive growth in the annual outturn of graduate and diploma lvel engineers.

In 1947-48 the annual outturn of graduate engineers was 1270 and diploma holder was 1438. This increased to 5603 and 7969 in 1960-61 respectively, thereby indicating an increase of 26% and 35% during the 13 years for the two types of technical personnel. The annual outturn during next twenty years 1960-61 to 1980-81, increased by 13% for degree level engineers and 17% for diploma level engineers.

In terms of different branches of specialization, the most marked increase was in the branches of Civil, Mechanical and Electrical engineering. The new emerging areas of the science and technology require specialised enginners such as chemical engineers, electronics engineers etc. The annual outturn in these branches did not show much improvement and during 22 year period between 1961-62 and 1983-84, there was an increase of 15% for chemical engineers, 4.8% for textile engineers and 10% for mining engineers. The annual outturn of Electronic and Telecommunication engineers showed the most impressive increase. It rose by 40% during the same period of 1961-62 and 1983-84. Taking into consideration that it was a twenty two year period, where annual intake as well as number of institutions registered phenomenal increase the growth of graduate engineers in these branches is not satisfactory.

The same position is observed in the diploma level engineers, except that the annual outturn of textile engineers was quite large, it was 296 in 1961-62 and increased to 1035 in 1983-84. For Architecture there were only 6 diploma level engineers in 1961-62, which increased to 317 in 1983-84 and considering the length of the period this increase is very modest and slow.

The growth rate of industrial production has also been very fluctuating. Sometimes the growth rate has increased at a rate of 9% but at other times it has even declined. During the year 1966-67 when economy went through recession the increase in industrial production had only been 0.3% over the previous year.

2. Main Conclusion

As stated earlier we have taken the growth of industrial production as indicating the demand for degree and diploma level engineers and the annual outturn as supply of these personnel. Matching the demand with the supply of engineers, we find that for the period under consideration, 1961-62 to 1983-84, the supply of graduate engineers has been less than the demand, But the supply of diploma level engineers has been more. The

supply of diploma level engineers has also been more than the supply of degree holder engineers. However if we disaggregate it and study the branch-wise breaking, than the picture that emerges is different.

In both the categories of engineers, the maximum outturn were in Civil, Mechanical and Electrical. The graduate engineers in Civil, Mechanical and Electrical engineering increased by more than 100% between 1961-62 and in 1983-84, and similarly the diploma level engineers increased by more than 200% during the same period in these branches.

The branches that had low outturn were Textile, Architecture, Mining and Electronics and Telecommunication. In absolute terms the increase in the outturn of graduate engineers in textile engineering was only 381 in 1983-84 from 185 in 1961-62. Similarly in Mining the outturn of degree holder engineers was only 63 in 1961-62 that increased to 208 in 1983-84. In terms of percentage the rise in outturn is impressive but when we consider that it is a 22 year period the increase comes out to be only 10%. This is sad because during this period there was considerable expansion in the number of institutions

as well as facilities. The outturn of diploma holder engineers also rose during the period 1961-62 and 1983-84, especially in the branches of Civil, Mechanical and Electrical engineering. In Mettalurgical engineering the outturn of diploma holders was only 190 in 1983-84, otherwise in the other branches such as Textile, Mining and Electronics and Telecommunication the outturn was quite large and was more than those of the graduate engineers. Thus in these branches middle level personnel increased more rapidly.

This study has its own limitations, due to which certain basic assumptions had to be made. We had to take the rate of growth of industrial production as representing the demand for engineering personnel because data was not available at the micro level from the industries on a comprehensive basis. It would have been better had the data been available about the actual amount of recruitment of engineers at various levels by both the private and public sectors. The other possibility of estimating demand was the number of vacancies advertised by different concerns. But again, the figures are not available about these neither can they be relied upon. Similarly, on the supply side the total outturn figures have been

taken to indicate the supply of engineers and it is taken as a flow variable, and not as stock variable. This is so because, figures about the stock of engineers on year wise basis is not available. As statistics referred to above become available the study could be extended in other meaningful directions.

Appendix A.1

Outturn of Degree-Holder Engineers of Formal System of Engineering and Technical Education in India by Specialization during 1961-62 ... 1983-84

A - Recognised Aided Institutions

S.No.	Specialization	YEARS				
		1961-62	1962-63	1963-64	1964-65	1965-66
1.	Civil	2232	2543	2710	2613	2515
2.	Mechanical	1829	2345	2540	2701	3136
3.	Electrical	1301	1688	1919	2173	2320
4.	Chemical	300	363	432	458	472
5.	Metallurgical	311	174	228	241	320
6.	Textile	185	174	173	148	187
7.	Architecture	150	156	164	144	233
8.	Mining	63	198	233	205	253
9.	Electronics & Telecomm.	179	250	288	244	258
10.	Others	343	408	369	374	415
	TOTAL	6893	8299	8986	9301	10109

S.No.	Specialization	YEARS					
		1966-67	1967-68	1968-69	1969-70	1970-71	1971-72
1.	Civil	2957	3150	3405	3098	3325	3141
2.	Mechanical	4047	4497	5165	5079	5887	5864
3.	Electrical	3033	3450	3917	3841	4647	4436
4.	Chemical	742	739	985	840	1321	1388
5.	Metallurgical	407	394	515	567	749	756
6.	Textile	167	182	221	253	324	310
7.	Architecture	345	274	244	235	426	403
8.	Mining	247	192	141	128	106	137
9.	Electronics & Telecomm.	352	388	462	492	764	878
10.	Others	581	437	568	914	920	885
	TOTAL	12878	13703	15623	15447	18469	18198

S.No.	Specialization	YEARS					
		1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
1.	Civil	2754	2742	3200	3884	4405	4285
2.	Mechanical	4975	4411	4056	4092	4660	4717
3.	Electrical	3864	3182	2833	2696	2912	3096
4.	Chemical	1323	1348	1312	1251	1177	1125
5.	Metallurgical	641	606	490	454	446	407
6.	Textile	268	319	376	333	349	336
7.	Architecture	465	488	395	459	502	442
8.	Mining	105	98	71	106	88	96
9.	Electronics & Telecomm.	944	944	1018	1152	1165	1312
10.	Others	758	855	895	880	850	890
	TOTAL	16097	14993	14646	15307	16554	16706

S.No.	Specialization	YEARS					
		1978-79	1979-80	1980-81	1981-82	1982-83	1983-84
1.	Civil	4793	4617	4850	5352	5901	6297
2.	Mechanical	5289	5379	5807	5639	5914	6117
3.	Electrical	3579	3628	6061	4029	4225	4305
4.	Chemical	1202	1187	1251	1322	1266	1312
5.	Metallurgical	496	529	513	486	552	560
6.	Textile	417	402	411	384	418	381
7.	Architecture	448	465	434	453	485	608
8.	Mining	166	188	133	154	180	208
9.	Electronics & Telecomm.	1447	1390	1470	1579	1621	1775
10.	Others	982	1014	1035	1148	1294	1503
	TOTAL	18819	18799	19929	20546	21856	23066

Note: The outturn figures of degree holder engineers provided by the Ministry of Education in consolidated survey Report of Facilities of Techical Education have been used after excluding the outturn of non-engineering degree courses such as Pharmacy, applied fine/arts etc. and they have also been adjusted for enabling them comparable and complete.

Sources:

1. Engineers in India, Number and Distribution 1955, Planning Commission 1957.
2. Technical Education in India Today, Ministry of Scientific Research and Cultural Affairs, Government of India, New Delhi.
3. Stock Taking of Engineering Personnel, Institute of Applied Manpower Research, New Delhi 1963.
4. Stock of High Level Manpower: Engineering Graduates and Diploma Holders, Institute of Applied Manpower Research, New Delhi 1979.
5. Division for Technical Education, Ministry of Education and Culture, Government of India.
6. Consolidated Reports entitled 'Survey of Technical Education Facilities in India, 1970-1975, Ministry of Education, New Delhi.
7. Survey Reports of Facilities for Technical Education 1976 to 1984, Northern, Eastern, Southern and Western Region.

Appendix A.2

Outturn of Diploma Holder Engineers in India by Specialization during 1961-62 ... 1983-84

S.No.	Specialization	YEARS					
		1961-62	1962-63	1963-64	1964-65	1965-66	1966-67
1.	Civil	4857	5206	5084	5528	6219	6352
2.	Mechanical	2375	3263	3689	4832	5931	8611
3.	Electrical	2091	2548	3123	3654	4279	5682
4.	Chemical	-	-	-	-	28	56
5.	Metallurgical	10	12	3	12	9	22
6.	Textile	296£	337£	319£	349£	289£	289*
7.	Architecture	6£	4£	4£	11*	11*	11*
8.	Mining	204	284	228	231	254	210
9.	Electronics & Telecomm.	93	116	131	136	129	113
10.	Others	417	276	357	324	471	835
	TOTAL	10349	12046	12938	15077	17620	22181

S.No.	Specialization	YEARS					
		1967-68	1968-69	1969-70	1970-71	1971-72	1972-73
1.	Civil	6202	5974	4812	3501	3163	2956
2.	Mechanical	8975	9338	8905	6455	5827	4892
3.	Electrical	5707	5904	6035	4316	4277	3762
4.	Chemical	56	89	147	87	147	103
5.	Metallurgical	61	125	86	104	98	82
6.	Textile	379*	397*	329*	290	359	325
7.	Architecture	8*	25*	29*	47	46	49
8.	Mining	204	84	95	67	74	80
9.	Electronics & Telecomm.	157	202	223	404	411	508
10.	Others	516	851	871	679	761	896
	TOTAL	22265	22989	21532	15950	15163	13653

S.No.	Specialization	YEARS					
		1973-74	1974-75	1975-76	1976-77	1977-78	1978-79
1.	Civil	4008	5796	7957	8582	8775	9860
2.	Mechanical	4378	5182	6009	7625	8913	9377
3.	Electrical	3573	4092	5198	5700	6393	7105
4.	Chemical	151	143	182	171	224	229
5.	Metallurgical	122	133	160	157	187	167
6.	Textile	394	421	493	536	522	612
7.	Architecture	67	66	129	125	178	184
8.	Mining	90	102	162	196	242	318
9.	Electronics & Telecomm.	719	786	881	929	1209	1334
10.	Others	969	1073	1076	1320	1630	1487
	TOTAL	14471	17796	22247	25341	28273	30673

S.No.	Specialization	YEARS				
		1979-80	1980-81	1981-82	1982-83	1983-84
1.	Civil	10268	11720	12828	14734	14111
2.	Mechanical	9822	10094	10273	10970	11137
3.	Electrical	7260	8250	8112	8314	8107
4.	Chemical	217	287	273	301	337
5.	Metallurgical	156	145	158	183	190
6.	Textile	693	718	748	1020	1035
7.	Architecture	209	164	224	371	317
8.	Mining	393	442	430	482	458
9.	Electronics & Telecomm.	1460	1416	1469	1787	1850
10.	Others	1652	1741	1821	1957	2508
	TOTAL	32130	34977	36336	40119	40050

£ Obtained from CSIR

* Obtained from IAMR

Note: The outturn figures of the diploma holder engineers, Ministry of Education provided by the Survey Reports of Facilities of Technical Education have been used after excluding outturn of non-technical diploma courses such as Pharmacy, Secretarial Practice etc. and they have also been adjusted for making them complete and comparable.

Sources: Same as for Table A.1

Appendix A.3

Growth in Degree and Diploma Holder Engineers of Formal System of Technical Education in India.

1961-62 ... 1983-84

YEAR	DEGREE LEVEL		DIPLOMA LEVEL	
	OUTTURN		OUTTURN	
	No.	Growth rate	No.	Growth rate
1960-61	-	-	-	-
1961-62	6893	23.02	10349	29.86
1962-63	8299	20.39	12046	16.39
1963-64	8986	8.27	12938	7.40
1964-65	9301	3.50	15077	16.53
1965-66	10109	8.68	17620	16.86
1966-67	12878	27.39	22181	25.88
1967-68	13703	6.40	22265	0.37
1968-69	15623	14.01	22989	3.25
1969-70	15447	- 1.12	21532	- 6.33
1970-71	18469	19.56	15950	- 25.9
1971-72	18198	- 1.46	15163	- 4.93
1972-73	16097	- 11.54	13653	- 0.09
1973-74	14993	- 6.85	14471	5.99
1974-75	14646	- 2.31	17796	22.97
1975-76	15307	4.51	22247	25.01

1976-77	16554	8.14	25341	13.90
1977-78	16706	0.91	28273	11.57
1978-79	18819	12.64	30673	8.48
1979-80	18799	- 0.10	32130	4.75
1980-81	19929	6.01	34977	8.86
1981-82	20546	3.09	36336	3.88
1982-83	21856	6.37	40119	10.41
1983-84	23066	5.53	40050	- 0.17

Sources: Table A.1 and A.2.

Appendix A.4

Growth Rate of Industrial Production

Percentage Increase over Previous Year

Year	Growth Rate
1961-62	6.6
1962-63	8
1963-64	9
1964-65	7
1965-66	5.1
1966-67	0.3
1967-68	0.5
1968-69	6.7
1969-70	7.4
1970-71	3.0
1971-72	3.3
1972-73	4.4
1973-74	- 0.2
1974-75	3.2
1975-76	7.2
1976-77	9.6
1977-78	4.2
1978-79	7.6
1979-80	- 1.7

1980-81	4.0
1981-82	9.3
1982-83	3.2
1983-84	6.7

Sources: Figures have been taken from various Economic Surveys.

Note: Growth rate are based on the old index of industrial production (Base 1970 = 100) upto 1980-81 and on new index (Base 1980-81 = 100) thereafter.

Appendix A.5

Growth Rate of Industrial Production and Degree Level & Diploma Level Engineers in India since 1961-62 to 1983-84

YEAR	Industrial Production	Degree Level	Diploma Level
	Growth rate	Growth rate	Growth rate
1960-61	-	-	-
1961-62	6.6	23.02	29.86
1962-63	8	20.39	16.39
1963-64	9	8.27	7.40
1964-65	7	3.50	16.53
1965-66	5.1	8.68	16.86
1966-67	0.3	27.39	25.88
1967-68	0.5	6.40	0.37
1968-69	6.7	14.01	3.25
1969-70	7.4	- 1.12	- 6.33
1970-71	3.0	19.56	- 25.9
1971-72	3.3	- 1.46	- 4.93
1972-73	4.4	- 11.54	- 0.09
1973-74	- 0.2	- 6.85	5.99
1974-75	3.2	- 2.31	22.97
1975-76	7.2	4.51	25.01
1976-77	9.6	8.14	13.90
1977-78	3.3	0.91	11.57

1978-79	7.6	12.64	8.48
1979-80	- 1.7	- 0.10	4.75
1980-81	4.0	6.01	8.86
1981-82	9.3	3.09	3.88
1982-83	3.2	6.37	10.41
1983-84	6.7	5.53	- 0.17

Source: The growth rate about industrial production has been taken from economic surveys and the degree level and diploma level has been computed.

Appendix A.6

Growth in Degree and Diploma Levels of Engineering and Technical Education in India 1947-48 to 1983-84

Degree Level

Year	Institutions		Actual Intake		Outturn	
	No.	Growth rate	No.	Grwoth rate	No.	Growth rate
1947-48	38	-	2940	-	1270	-
1950-51	49	9.6	4119	13.4	2198	24.4
1955-56	64	6.1	5939	8.8	4017	16.6
1960-61	102	11.9	13692	26.1	5603	7.9
1965-66	133	6.1	23315	14.1	10109	16.1
1970-71	134	0.2	13610	- 8.3	18469	15.9
1975-76	134	0.0	22104	12.5	15307	- 3.4
1980-81	166	4.8	29650	6.8	19929	6.0
1983-84	205	7.8	39492	11.1	24699	8.0
Over all average Grwoth rate (Taking 1947-48 as base)		12.2		35.8		51.2

Diploma Level

Year	Institutions		Actual Intake		Outturn	
	No.	Growth rate	No.	Growth rate	No.	Growth rate
1947-48	53	-	3670	-	1438	-
1950-51	86	20.8	5903	20.3	1748	6.9
1955-56	102	3.7	9397	11.8	3872	18.6
1960-61	195	18.2	23736	30.5	7969	21.2
1965-66	274	8.1	43984	17.1	17620	22.2
1970-71	301	2.0	28341	- 7.1	15950	- 1.9
1975-76	311	0.7	43898	11.0	22247	7.9
1980-81	355	1.5	50505	3.0	34977	11.4
1983-84	526	19.0	66270	10.4	40050	4.8
Overall average Growth rate (Taking 1947-48 as base)		24.8		47.4		74.6

Annual Growth rate has been worked out for each time specific period ie 1947-48 to 1950-51 etc.

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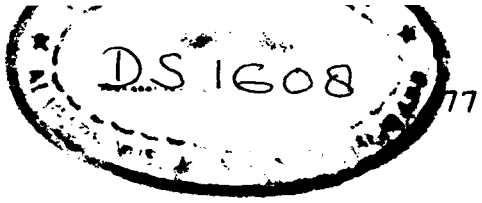

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